HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Kendall Creek "Winter" Steelhead Program
Species or Hatchery Stock:	Steelhead (*Onchorynchus mykiss*) Kendall Creek
Agency/Operator:	Washington Department of Fish and Wildlife
Watershed and Region:	Nooksack River Puget Sound
Date Submitted:	March 17, 2003
Date Last Updated:	January 24, 2003

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Kendall Creek "Winter" Steelhead Program

1.2) Species and population (or stock) under propagation, and ESA status.

Kendall Creek Steelhead (*Onchorynchus mykiss*) - not listed

1.3) Responsible organization and individuals

Name (and title):	Chuck Phillips, Region 4 Fish Program Manager	
	Ted Thygesen, Nooksack Complex Manager	
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Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

Volunteers operate, maintain and rear at McKinnon Pond 50,000 steelhead. It is located on the middle fork of the Nooksack River.

1.4) Funding source, staffing level, and annual hatchery program operational costs.

The funding source is from Wildlife State fund(staffing), but steelhead feed is charged against the Nooksack Aquatic Lands Enhancement Account (ALEA) code. Unsure of operating costs.

1.5) Location(s) of hatchery and associated facilities.

Kendall Creek Hatchery:	NF Nooksack River (01.0120) RM 46 at confluence with Kendall Creek (01.0406) , Puget Sound, Washington
McKinnon Pond:	MF Nooksack River (01.0339) RM 4.8 near the confluence with un-named stream (01.0352) that emminates from peat bogs and beaver dams.

1.6) Type of program.

Isolated harvest

1.7) Purpose (Goal) of program.

Augmentation

The goal of this program is to provide fish for sport and tribal harvest opportunity.

1.8) Justification for the program.

This program will be operated to provide fish for harvest while minimizing adverse effects on listed fish. This will be accomplished in the following manner:

1. Release steelhead as smolts with expected brief freshwater residence.

2. Attempt time of release not to coincide with out-migration of listed fish.

3. Only appropriate stock will be propagated.

4. Mark all reared fish.

5. Hatchery fish will be propagated using appropriate fish culture methods and consistent with Co-Managers Fish Health Policy and state and federal water quality standards; e.g. NPDES criteria.

1.9) List of program "Performance Standards".

See section 1.10.

1.10) List of program "Performance Indicators", designated by "benefits" and "risks."

Performance Standards and Indicators for Puget Sound **Isolated Harvest** steelhead programs.

Performance Standard	Performance Indicator	Monitoring and Evaluation Plan
Produce adult fish for harvest	Survival and contribution rates	Monitor catch
Meet hatchery production goals	Number of juvenile fish released - **150,000**	Future Brood Document (FBD) and hatchery records

Manage for adequate escapement where applicable	Hatchery return rates	Hatchery return records
Minimize interactions with listed fish through proper broodstock management and mass marking. Maximize hatchery adult capture effectiveness. Use only hatchery fish	Number of broodstock collected - **86-100**	Rack counts
	Stray Rates	Spawning guidelines
	Sex ratios	
	Age structure	Hatchery records
	Timing of adult collection/spawning - **late December-March**	Spawning guidelines Hatchery records
	Adherence to spawning guidelines - **see section 8.3**	
	Total number of wild adults passed upstream - **0**	
Minimize interactions with listed fish through proper rearing and release strategies	Juveniles released as smolts	FBD and hatchery records
	Out-migration timing of listed fish / hatchery fish - **April thru June (chinook) / May 1-15 steelhead**	FBD and historic natural outmigration times FBD and hatchery records
	Size and time of release - **5 fpp/ May 1-15**	Hatchery records (marked vs unmarked)
	Hatchery stray rates	
Maintain stock integrity and genetic diversity	Effective population size	Spawning guidelines
	Hatchery-Origin Recruit spawners	

Maximize in-hatchery survival of broodstock and their progeny; and Limit the impact of pathogens associated with hatchery stocks, on listed fish	Fish pathologists will monitor the health of hatchery stocks on a monthly basis and recommend preventative actions / strategies to maintain fish health	Co-Managers Disease Policy
	Fish pathologists will diagnose fish health problems and minimize their impact	Fish Health Monitoring Records
	Vaccines will be administered when appropriate to protect fish health	
	A fish health database will be maintained to identify trends in fish health and disease and implement fish health management plans based on findings	
	Fish health staff will present workshops on fish health issues to provide continuing education to hatchery staff.	
Ensure hatchery operations comply with state and federal water quality standards through proper environmental monitoring	NPDES compliance	Monthly NPDES records

1.11) Expected size of program.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).

The intent is to use local broodstock, but to date have not been able to meet program needs without the transfer of Skagit, Tokul Creek or Bogachiel stocks.

The egg take goal is 175,000. The average fecundity for Nooksack steelhead females is

3,500 eggs. The normal male to female ratio ranges between 50:50 and 60:40 which would make the range needed for egg take to be 86 to 100 adults. Only 18 adults were trapped at the Kendall Creek holding pond between late December and early February, 2001. Of these, 8 were females.

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location.

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling		
Yearling	Kendall Creek (Nooksack R., 01.0120)	*150,000

*- 50,000 are transferred to McKinnon Ponds where they are reared. For release, they are trucked back to Kendall Creek where they are acclimated and released.

**- Approximately 5,000 fish are transferred to Whatcom Creek Hatchery (WCH) where they are reared and released into Whatcom Creek (See Whatcom Creek steelhead HGMP).

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

1.13) Date program started (years in operation), or is expected to start.

Kendall Cr. - 1990-1991
McKinnon Pond - 1988

1.14) Expected duration of program.

Ongoing

1.15) Watersheds targeted by program.

Nooksack River (01.0120)

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

NA

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS.

2.1) List all ESA permits or authorizations in hand for the hatchery program.

None

2.2) Provide descriptions, status, and projected take actions and levels for ESA-listed natural populations in the target area.

2.2.1) Description of ESA-listed salmonid population(s) affected by the program.

- Identify the ESA-listed population(s) that will be directly affected by the program.

- Identify the ESA-listed population(s) that may be incidentally affected by the program.

Puget Sound Chinook and Bull Trout/Dolly Varden. Three stocks of chinook are identified in the Nooksack basin. They are North Fork Nooksack Chinook, South Fork Nooksack Chinook, and Samish, Mainstem Nooksack Fall Chinook. The first two are of native origin and the health of the populations as per SASSI is considered “critical”. The third is an introduced hatchery stock. Its status is “unknown”.

Native chinook enter the Nooksack from April through early September. Spawning occurs in August and September. Outmigration of juveniles occurs in the spring.

Three stocks of native char have been identified in the Nooksack basin. These are the Lower Nooksack, Canyon Creek and Upper Middle Fork stocks. The latter is isolated from the rest of the basin due to a diversion dam. The USFWS is supportive of laddering the dam to provide passage. Char exhibit anadromous, fluvial, and resident life histories. Spawning occurs in the fall. After spawning, anadromous adults move downriver and enter the estuary during the spring while fluvial adults disperse throughout the upper river. Sub-adults may also enter the river from the estuary in late winter and early spring. Adults return to spawning staging areas in late summer.

There are no data on char population sizes and the status of the stocks is unknown.

2.2.2) Status of ESA-listed salmonid population(s) affected by the program.

- Describe the status of the listed natural population(s) relative to “critical” and “viable” population thresholds

Critical and viable population thresholds under ESA have not been determined yet, however, the SASSI report determined that the NF and SF chinook are "critical". Dolly

Varden/Bull Trout are "unknown".

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.

For the North Fork, wild / hatchery ratio for 1995 to 1999 = .31:1 average (range 3.3:1 to .11:1). The recruit / spawner ratio range for 1995 to 1999 = .00000 to .53333 fish per spawner.

There is limited data for the South Fork wild/hatchery ratios in these categories (Pete Castle, Area Biologist, WDFW).

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

ESTIMATED ESCAPEMENT OF NOOKSACK CHINOOK STOCKS

YEAR	SOUTH FORK CHINOOK	NORTH FORK CHINOOK
1984	188	45
1985	445	255
1986	170	224
1987	248	179
1988	233	452
1989	606	300
1990	142	10
1991	365	107
1992	103	493
1993	235	445
1994	118	45
1995	290	230
1996	203	535
1997	180	617
1998	157	370
1999	213	892

Note: In 1999 and 2000, 55.6% and 32.4%, respectively, of the carcasses surveyed in the SF Nooksack were strays from the NF Nooksack Kendall stock rebuilding program (Ned Currance, Nooksack tribal biologist, personal communication).

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

Year	Overall Escapement	Number of natural-origin
1995	230	175
1996	535	210
1997	617	121
1998	370	39
1999	892	91
2000	1242	157

2.2.3) Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take.

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

The release of fish as described in this HGMP could potentially result in ecological interactions with listed species. These potential ecological interactions are discussed in Section 3.5, and risk control measures are discussed in Section 10.11. Implementation of the program modifications provided in this HGMP, and the actions previously taken by the comanagers, are anticipated to contribute to the continued improvement in the abundance of listed salmonids.

Collection of steelhead broodstock takes place between December and early March oustide the return time of the spring, summer and fall chinook runs. No likely effects to "take" of listed chinook.

- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

Unknown

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

See "take" table at end of HGMP.

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

None.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

None.

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

Puget Sound Salmon Management Plan and the Future Brood Document

3.3) Relationship to harvest objectives.

3.3.1) Describe fisheries benefitting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

Nooksack River tribal (Lummi and Nooksack) commercial steelhead net fisheries and Nooksack River recreational steelhead fisheries. Goal is a 90% harvest rate.

3.4) Relationship to habitat protection and recovery strategies.

The comanagers' resource management plans for artificial production in Puget Sound are expected to be one component of a recovery plan for Puget Sound chinook under development through the Shared Strategy process. Several important analyses have been completed, including the identification of populations of Puget Sound chinook, but further development of the plan may result in an improved understanding of the habitat, harvest, and hatchery actions required for recovery of Puget Sound chinook.

3.5) Ecological interactions.

The program described in this HGMP interacts with the biotic and abiotic components of the freshwater, estuarine, and marine salmonid ecosystem through a complex web of short and longterm processes. The complexity of this web means that secondary or tertiary interactions (both positive and negative) with listed species could occur in multiple time periods, and that evaluation of the net effect can be difficult. WDFW is not aware of any studies that have directly evaluated the ecological effects of this program. Alternatively, we provide in this section a brief summary of empirical information and theoretical analyses of three types of ecological interactions, nutrient enhancement, predation, and competition, that may be relevant to this program. Recent reviews by Fresh (1997), Flagg et al. (2000), and Stockner (2003) can be consulted for additional information; NMFS (2002) provides an extensive review and application to ESA permitting of artificial production programs.

Nutrient Enhancement
Adults originating from this program that return to natural spawning areas may provide a source of nutrients in oligotrohic coastal river systems and stimulate stream productivity. Many watersheds in the Pacific Northwest appear to be nutrient-limited (Gregory et al. 1987; Kline et al. 1997) and salmonid carcasses can be an important source of marine derived nutrients (Levy 1997). Carcasses from returning adult salmon have been found to elevate stream productivity through several pathways, including: 1) the releases of nutrients from decaying carcasses has been observed to stimulate primary productivity (Wipfli et al. 1998); 2) the decaying carcasses have been found to enrich the food base of aquatic invertebrates (Mathisen et al. 1988); and 3) juvenile salmonids have been observed to feed directly on the carcasses (Bilby et al. 1996). Addition of nutrients has been observed to increase the production of salmonids (Slaney and Ward 1993; Slaney et al. 2003; Ward et al. 2003).

Predation – Freshwater Environment
Coho and steelhead released from hatchery programs may prey upon listed species of salmonids, but the magnitude of predation will depend upon the characteristic of the listed population of salmonids, the habitat in which the population occurs, and the characteristics of the hatchery program (e.g., release time, release location, number released, and size of fish released). The site specific nature of predation, and the limited number of empirical studies that have been conducted, make it difficult to predict the predation effects of any specific hatchery program. WDFW is unaware of any studies that have empirically estimated the predation risks to listed species posed by the program described in this HGMP.

In the absence of site-specific empirical information, the identification of risk factors can be a useful tool for reviewing hatchery programs while monitoring and research programs are developed and implemented. Risk factors for evaluating the potential for significant predation include the following:

<u>Environmental Characteristics.</u> Water clarity and temperature, channel size and configuration, and river flow are among the environmental characteristics that can influence the likelihood that predation will occur (see SWIG (1984) for a review). The SIWG (1984) concluded that the potential for predation is greatest in small streams with flow and turbidity conditions conducive to high visibility.

<u>Relative Body Size.</u> The potential for predation is limited by the relative body size of fish released from the program and the size of prey. Generally, salmonid predators are thought to prey on fish approximately 1/3 or less their length (USFWS 1994), although coho salmon have been observed to consume juvenile chinook salmon of up to 46% of their total length (Pearsons et al. 1998). The lengths of juvenile migrant chinook salmon originating from natural production have been monitored in numerous watersheds throughout Puget Sound, including

the Skagit River , Stillaguamish River, Bear Creek, Cedar River, Green River, Puyallup River, and Dungeness River. The average size of migrant chinook salmon is typically 40mm or less in February and March, but increases in the period from April through June as emergence is completed and growth commences (Table 3.5.1). Assuming that the prey item can be no greater than 1/3 the length of the predator, Table 3.5.1 can be used to determine the length of predator required to consume a chinook salmon of average length in each time period. The increasing length of natural origin juvenile chinook salmon from March through June indicates that delaying the release hatchery smolts of a fixed size will reduce the risks associated with predation.

Table 3.5.1. Average length by statistical week of natural origin juvenile chinook salmon migrants captured in traps in Puget Sound watersheds. The minimum predator length corresponding to the average length of chinook salmon migrants, assuming that the prey can be no greater than 1/3 the length of the predator, are provided in the final row of the table. (NS: not sampled.)

Watershed	Statistical Week										
	16	17	18	19	20	21	22	23	24	25	26
Skagit [1] 1997-2001	43.2	48.3	50.6	51.7	56.1	59.0	58.0	60.3	61.7	66.5	68.0
Stillaguamish [2] 2001-2002	51.4	53.5	55.7	57.8	60.0	62.1	64.2	66.4	68.5	70.6	72.8
Cedar [3] 1998-2000	54.9	64.2	66.5	70.2	75.3	77.5	80.7	85.5	89.7	99.0	113
Green [4] 2000	52.1	57.2	59.6	63.1	68.1	69.5	NS	79.0	82.4	79.4	76.3
Puyallup [5] 2002	NS	NS	NS	66.2	62.0	70.3	73.7	72.7	78.7	80.0	82.3
Dungeness [6] 1996-1997	NS	NS	NS	NS	NS	NS	NS	NS	77.9	78.8	81.8
All Systems Average Length	50.4	55.8	58.1	61.8	64.3	67.7	69.2	72.8	76.5	79.0	82.4
Minimum Predator Length	153	169	176	187	195	205	210	221	232	239	250

Sources:

[1] Data are from Seiler et al. (1998); Seiler et al. (1999); Seiler et al. (2000); Seiler et al. (2001), and Seiler et al. (2002)..

[2] Data are from regression models presented in Griffith et al. (2001) and Griffith et al. (2003).

[3] Data are from Seiler et al. (2003).

[4] Data are from Seiler et. (2002).

[5] Data are from Samarin and Sebastian (2002).

[6] Data are from Marlowe et al. (2001).

Date of Release. The release date of juvenile fish for the program can influence the likelihood that listed species are encountered or are of a size that is small enough to be consumed. The most extensive studies of the migration timing of naturally produced juvenile chinook salmon in the Puget Sound ESU have been conducted in the Skagit River, Bear Creek, Cedar River, and the Green River. Although distinct differences are evident in the timing of migration between watersheds, several general patterns are beginning to emerge:

1) Emigration occurs over a prolonged period, beginning soon after enough emergence (typically January) and continuing at least until July;
2) Two broad peaks in migration are often present during the January through July time period; an early season peak (typically in March) comprised of relatively small chinook salmon (40-45mm), and a second peak in mid-May to June comprised of larger chinook salmon;
3) On average, over 80% of the juvenile chinook have migrated past the trapping locations after statistical week 23 (usually occurring in the first week of June).

Table 3.5.2. Average cumulative proportion of the total number of natural origin juvenile chinook salmon migrants estimated to have migrated past traps in Puget Sound watersheds.

Watershed	Statistical Week										
	16	17	18	19	20	21	22	23	24	25	26
Skagit [1] 1997-2001	0.61	0.64	0.68	0.73	0.76	0.78	0.83	0.86	0.90	0.92	0.94
Bear [2] 1999-2000	0.26	0.27	0.28	0.32	0.41	0.52	0.73	0.84	0.92	0.96	0.97
Cedar [2] 1999-2000	0.76	0.76	.0.76	0.77	0.79	0.80	0.82	0.84	0.87	0.88	0.90
Green [3] 2000	0.63	0.63	0.64	0.69	0.77	0.79	0.84	0.86	0.88	0.98	1.00
All Systems Average	0.56	0.58	0.59	0.63	0.68	0.72	0.80	0.85	0.89	0.94	0.95

Sources:

[1] Data are from Seiler et al. (1998); Seiler et al. (1999); Seiler et al. (2000); Seiler et al. (2001), and Seiler et al. (2002)..

[2] Data are from Seiler et al. (2003).

[3] Data are from Seiler et. (2002).

Release Location and Release Type. The likelihood of predation may also be affected by the location and type of release. Other factors being equal, the risk of predation may increase with the length of time the fish released from the artificial production program are commingled with the listed species. In the freshwater environment, this is likely to be affected by distribution of the listed species in the watershed, the location of the release, and the speed at which fish released from the program migrate from the watershed.

Coho salmon and steelhead released from western Washington artificial production programs as smolts have typically been found to migrate rapidly downstream. Data from Seiler et al. (1997; 2000) indicate that coho smolts released from the Marblemount Hatchery on the Skagit River migrate approximately 11.2 river miles day. Steelhead smolts released onstation may travel even more rapidly – migration rates of approximately 20 river miles per day have been observed in the Cowlitz River (Harza 1998). However, trucking fish to offstation release sites, particularly release sites located outside of the watershed in which the fish have been reared, may slow migrations speeds (Table 3.5.3).

Table 3.5.3. Summary of travel speeds for steelhead smolts for several types of release strategies.

Location	Release Type	Migration Speed (river miles per day)	Source
Cowlitz River	Smolts, onstation	21.3	Harza (1998)
Kalama River	Trucked from facility located within watershed in which fish were released.	4.4	Hulett (pers. comm.)
Bingham Creek	Trucked from facility located outside of watershed in which fish were released.	0.6	Seiler et al (1997)
Stevens Creek	Trucked from facility located outside of watershed in which fish were released.	0.5	Seiler et al (1997)
Snow Creek	Trucked from facility located outside of watershed in which fish were released.	0.4	Seiler et al (1997)

Number Released. Increasing the number of fish released from an artificial production program may increase the risk of predation, although competition between predators for prey may eventually limit the total consumption (Peterman and Gatto 1978).

Predation – Marine Environment

WDFW is unaware of any studies that have empirically estimated the predation risks to listed species posed by the program described in this HGMP. NMFS (2002) reviewed existing information on the risks of predation in the marine environment posed by artificial production programs and concluded:

> "1) Predation by hatchery fish on natural-origin smolts or sub-adults is less likely to occur than predation on fry. Coho and chinook salmon, after entering the marine environment, generally prey upon fish one-half their length or less and consume, on average, fish prey that is less than one-fifth of their length (Brodeur 1991). During early marine life, predation on natural origin chinook, coho, and steelhead will likely be highest in situations where large, yearling-sized hatchery fish encounter sub-yearling fish or fry (SIWG 1984)."
>
> "2) However, extensive stomach content analysis of coho salmon smolts collected through several studies in marine waters of Puget Sound, Washington do not substantiate any indication of significant predation upon juvenile salmonids (Simestad and Kinney 1978)."
>
> "3) Likely reasons for apparent low predation rates on salmon juveniles, including chinook, by larger chinook and other marine predators are described by Cardwell and Fresh (1979). These reasons included: 1) due to rapid growth, fry are better able to elude predators and are accessible to a smaller proportion of predators due to size alone; 2) because fry have dispersed, they are present in low densities relative to other fish and invertebrate prey; and 3) there has either been learning or selection for some predator avoidance."

Competition
WDFW is unaware of any studies that have empirically estimated the competition risks to listed species posed by the program described in this HGMP. Studies conducted in other areas indicate that this program is likely to pose a minimal risk of competition:

> 1) As discussed above, coho salmon and steelhead released from hatchery programs as smolts typically migrate rapidly downstream. The SIWG (1984) concluded that "migrant fish will likely be present for too short a period to compete with resident salmonids."
> 2) NMFS (2002) noted that "..where interspecific populations have evolved sympatrically, chinook salmon and steelhead have evolved slight differences in habitat use patterns that minimize their interactions with coho salmon (Nilsson 1967; Lister and Genoe 1970; Taylor 1991). Along with the habitat differences exhibited by coho and steelhead, they also show differences in foraging behavior. Peterson (1966) and Johnston (1967) reported that juvenile coho are surface oriented and feed primarily on drifting and flying insects, while steelhead are bottom oriented and feed largely on benthic invertebrates."
> 3) Flagg et al. (2000) concluded, "By definition, hatchery and wild salmonids will not compete unless they require the same limiting resource. Thus, the modern enhancement strategy of releasing salmon and steelhead trout as smolts markedly reduces the potential for hatchery and wild fish to compete for resources in the freshwater rearing environment. Miller (1953), Hochachka (1961), and Reimers

(1963), among others, have noted that this potential for competition is further reduced by the fact that many hatchery salmonids have developed different habitat and dietary behavior than wild salmonids." Flagg et al (2000) also stated "It is unclear whether or not hatchery and wild chinook salmon utilize similar or different resources in the estuarine environment."
4) Fresh (1997) noted that "Few studies have clearly established the role of competition and predation in anadromous population declines, especially in marine habitats. A major reason for the uncertainty in the available data is the complexity and dynamic nature of competition and predation; a small change in one variable (e.g., prey size) significantly changes outcomes of competition and predation. In addition, large data gaps exist in our understanding of these interactions. For instance, evaluating the impact of introduced fishes is impossible because we do not know which nonnative fishes occur in many salmon-producing watersheds. Most available information is circumstantial. While such information can identify where inter- or intra specific relationships may occur, it does not test mechanisms explaining why observed relations exist. Thus, competition and predation are usually one of several plausible hypotheses explaining observed results."

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

Incubation and initial rearing of steelhead at Kendall Creek is done strictly on well water. Temperature is a constant 47° F. Generally, 80-100 gallons per minute (gpm) are needed for rearing in the Capilanos (starter troughs) for the program. Once the group is transferred to 3500 cubic foot raceways, 200-500 gpm is needed. After the Whatcom Creek Hatchery (WCH)(5k) and McKinnon pond (50k) transfers are completed in October, the remaining steelhead for release at Kendall Creek (100k) are reared on Kendall Creek water (if Kendall Creek water is available in November). These fish are reared in a 13,500 cubic foot raceway supplied with 500-700 gpm of Kendall Creek water (if available). The rearing at Kendall Creek is under the NPDES permit WAG-133007. Kendall Creek is a seasonal stream that goes dry in the summer.

McKinnon Pond is fed by surface water from stream (01.0352) locally known as Peat Bog Creek. It's water temperature ranges from 38 F - 45 F. The intake pipes (6) are deadheaded into a screened section of the creek. The water travels down to a screened collection box which removes debris. The 8" supply line then travels down to a 4" manifold which supplies the 300' pond. Flow to this pond has been normally 450 gpm, but recently has been upgraded through some effort to 800-900 gpm.

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for

the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

The Kendall Creek gravity intake does not have compliant intake screens. These screens are identified for replacement but are a lower priority than others since listed chinook are not passed above the rack on Kendall Creek.

Kendall Creek conducts effluent monitoring and reporting under the NPDES permit WAG-133007.

McKinnon Pond is fed by surface water from stream (01.0352) locally known as Peat Bog Creek. The intake pipes (6) are deadheaded into a screened section of the creek. The water travels down to a screened collection box which removes debris. The 8" supply line then travels down to a 4" manifold which supplies the 300' pond. No fish get above the rearing pond.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Fish are collected at the Kendall Creek Hatchery holding pond. Returning adults enter the ladder from Kendall Creek and hold in the pond. They are hand transferred to Capilano troughs to prevent jumping and escape.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Adults are transported to the the Capilanos via a tractor and fish tote with water.

5.3) Broodstock holding and spawning facilities.

Adults are spawned directly from the Capilanos.

5.4) Incubation facilities.

Eggs are incubated in vertical incubators using well water which is a constant 47 F.

5.5) Rearing facilities.

Fish are reared in shallow troughs indoors or Capilano troughs outdoors. They are then transferred to raceways (100' X 10' X 3.5'). After the WCH and McKinnon steelhead transfers are complete, the remaining fish for release at Kendall Creek Hatchery are transferred to a raceway (135' X 20' X 5').

McKinnon Pond is an asphalt rearing pond (292' X 42' X 6') with a concrete collection raceway at the end.

5.6) Acclimation/release facilities.

Fish are released from raceway ponds at Kendall Creek.

McKinnon Pond steelhead have been released from the pond in the past. But because of main channel movement and a lack of tributary supplement, these fish are seined out of the pond and trucked back to Kendall Creek for acclimation and release.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

None.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

The hatchery will be staffed full-time and equipped with a low-water alarm system to help prevent catastrophic fish loss resulting from water system failure. At Kendall Creek a generator and backup well pumps are available. A Fish Health Specialist monitors the health of the fish and prescribes proper treatment to minimize loss.

McKinnon Ponds is staffed and run part-time by a volunteer effort from the Mt. Baker HS AG program. Someone is at the facility 5 days per week while fish are there. Initially, fish are fed by hand, but later demand feeders are used. No power is available. A Fish Health Specialist monitors the health of the fish and prescribes proper treatment to minimize loss.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1) Source.

Eggs are collected from volunteer steelhead returning to the trap at Kendall Creek Hatchery or supplemented with Skagit, Tokul Creek, or Bogachiel stocks.

6.2) Supporting information.

6.2.1) History.

Kendall Creek stock is used whenever possible, but the majority of the steelhead program rests on the introduction of imported stocks from other watersheds.

6.2.2) Annual size.

Currently, 86-100 volunteer trapped steelhead are needed for broodstock. In most cases, eyed eggs from other broodstocks are shipped in to meet program needs.

6.2.3) Past and proposed level of natural fish in broodstock.

All fish used for broodstock are hatchery-origin fish. They have been 100% identified with an adipose-fin clip.

6.2.4) Genetic or ecological differences.

Unknown

6.2.5) Reasons for choosing.

The broodstock was originally derived from Chambers Creek stock. Over the years, Skagit, Tokul Creek and Bogachiel stocks have been used.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

NA

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Adults.

7.2) Collection or sampling design.

Adults are captured by a weir trap on Kendall Creek. They enter the holding pond via a fish ladder. A finger weir is used to keep the adults from escaping the holding pond.

7.3) Identity.

All fish to be used for broodstock are identified by an adipose-fin clip.

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):

The egg take goal is 175,000 for the programmed planting of 155,000 steelhead (see section 9.1.1). Volunteer trapped steelhead fecundity averages 3,500 eggs per female. The sex ratio for males and females ranges between 50:50 and 60:40. Adults needed range from 86-100.

Values are unknown for our imported stocks.

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

Year	Adults			Eggs	Juveniles
	Females	Males	Jacks		
1988					
1989					
1990					
1991					
1992					
1993					
1994					
1995					
1996					
1997					
1998					
1999					
2000	8	10		21,000	
2001					

Data source: Kendall Cr. hatchery records

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

All local Kendall Creek stock are trapped, if available. No fish are surplused.

7.6) Fish transportation and holding methods.

Adults are transported to the the Capilanos via a tractor and fish tote with water. Adults are spawned directly from the Capilanos.

7.7) Describe fish health maintenance and sanitation procedures applied.

Consistent with Co-Managers Salmonid Disease Control Policy.

7.8) Disposition of carcasses.

Adults are spawned, double operculum punched, and then deposited into the North Fork of the Nooksack River for nutrient enhancement.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

NA

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.

Adults are selected randomly throughout the entire run time.

8.2) Males.

Males are spawned 2 males for every female. A backup is utilized. On occasion have had to use live spawners, when males are limited, but never have had to use repeat spawners.

8.3) Fertilization.

2:1 matings with pooled gametes of 2 or 3 females per incubator.

8.4) Cryopreserved gametes.

NA

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

NA

SECTION 9. INCUBATION AND REARING -

Specify any management *goals* (e.g. "egg to smolt survival") that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

175,000 eggs are needed for a planting program goal of 155,000 (On-station: 150,000) (Whatcom Cr: 5,000; see Whatcom Creek steelhead HGMP) Generally, survival to ponding is about 95 %. Unless the Kendall stock is supplemented with eyed eggs from other watersheds we wouldn't meet our program goals.

9.1.2) Cause for, and disposition of surplus egg takes.

Surplus eggs are not taken.

9.1.3) Loading densities applied during incubation.

Eyed eggs transferred in average 3000/ pound (lb). Kendall Creek steelhead average 4000-5000/lb.(green) and 3500/lb.(eyed). Densities into vertical incubators are at 10,000 per tray (with Vexar) and a flow of 4 gpm.

9.1.4) Incubation conditions.

Eggs are incubated in well water. The water temperature is a constant 47°F. Dissolved oxygen is monitored and minimum criteria is 8 parts per million (ppm).

9.1.5) Ponding.

Ponding is forced. Each egg take is monitored using a KD factor. The appropriate range is 1.80 - 1.85. This is approximately 1200-1250 Temperature Units (TU's).

9.1.6) Fish health maintenance and monitoring.

Formalin is delivered via a metered drip method from a closed system to treat eggs for fungus. Egg mortality is removed prior to hatching. Vexar substrate is used to improve egg development.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

NA

9.2) Rearing:

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available..

Fry to smolt loss can average between 25-30,000.

9.2.2) Density and loading criteria (goals and actual levels).

Density levels are kept below 1.6 lbs./cubic foot at release. No more than 10 lbs./ gpm with creek water, higher with well water.

9.2.3) Fish rearing conditions

Fish are reared on well water strictly until after the WCH (5,000), and McKinnon Pond (50,000) transfers are completed in October. The remainder of steelhead for release at Kendall Creek (100,000) are reared on Kendall Creek water (if available). Dissolved oxygen is monitored to assure levels are above 8 ppm.

At McKinnon Pond, the critical factor is flow not volume. They usually won't exceed 10 lbs./ gpm.

9.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.

Not available.

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.

Not available.

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Steelhead are ponded at 2,000-2,500 fish per pound (fpp). They are belt feeder fed for 12 hrs./ day, 7 days/ week on NUTRA 2000 #0(Start - 500 fpp), #1(500-275 fpp). They are fed at 3.5% B.W./day. Fish are fed NUTRA 2000 #2(275-125 fpp) and NUTRA 2000 1.2mm(125-75 fpp) by hand. They are fed at 2.0-2.5% B.W./day (4-6 times/day). Fish are fed NUTRA 2000 1.5mm(75-40 fpp) and NUTRA 2000 2.0mm(40-25 fpp) by hand. They are fed at 1.5%B.W./day (3-4 times/day). Fish are fed NUTRA 2000 2.5mm(25-7.5 fpp) and NUTRA 20003.5mm(7.5-5 fpp) by hand. They are fed at 1.0-1.5% B.W./day (2-3 times/day).

McKinnon Ponds are fed initially by hand and then with demand feeders. Feed sizing changes are consistent with proper hatchery protocol adopted at Kendall Creek Hatchery.

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Consistent with Co-Managers Salmonid Disease Control Policy.

McKinnon Ponds follows the same protocol adopted at Kendall Creek Hatchery.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.

NA

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.

NA

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.

Steelhead will be reared to smolts and released to emigrate the system quickly and not impact listed fish.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs				
Unfed Fry				
Fry				
Fingerling				
Yearling	150,000	5	May 1-15	Kendall Creek

------->* ~5,000 yearlings transferred to Whatcom Creek Hatchery (WCH) in October, planted after May 1 @ 5 fpp (5,000 planted in Whatcom Creek). No more steelhead to be planted into the Samish River.

10.2) Specific location(s) of proposed release(s).

Stream, river, or watercourse: Nooksack River (01.0120)
Release point: Kendall Creek (01.0406) at RM 46 with confluence with Nooksack River.
Major watershed: Nooksack River
Basin or Region: Puget Sound

10.3) Actual numbers and sizes of fish released by age class through the program.

Release year	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1988								
1989								
1990								
1991								
1992								
******								
1999					Volitional	4/26-5/4/99	33,900	6.0
1999					Forced	after 5/1	25,000	6.0
2000					Forced	5/1/00	35,000	5.0
2000					Forced	after 5/1	30,000	6.0
2001					Forced	5/2/01	31,000	5.0
2001			**	Weighed-	Trucked	5/1/01	6,000	6.0
			(Otter ;	Screen	problems)			

Data source: Kendall Cr. hatchery records

10.4) Actual dates of release and description of release protocols.

Steelhead are released from May 1 to May 15, during high spring glacial runoff, to encourage quick migration to salt water and to provide visual protection for listed chinook juveniles.

10.5) Fish transportation procedures, if applicable.

Forced release from the Kendall Creek Hatchery out of raceway.

Fish that need transporting are those transferred to Whatcon Creek Hatchery, in October, and to McKinnon Pond. A 1000 gallon tanker with air stones and re-circulating pumps is used.

10.6) Acclimation procedures.

Kendall Creek Hatchery releases are, in most cases, acclimated on 100% Kendall Creek water, if available.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

All steelhead are 100% identified with an adipose-fin clip (mass marked).

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

Kendal Creek - Does not apply

10.9) Fish health certification procedures applied pre-release.

Fish are monitored by a Fish Health Specialist prior to release.

10.10) Emergency release procedures in response to flooding or water system failure.

Flooding is not a problem at Kendall Creek. Water system failure is backed up by generators and creek water.

McKinnon Pond - There is no power to this remote site. If a major event would happen someone would have to be present. Otherwise, the fish might expire. If someone were present, contacts would be made to get pumps to the site to re-circulate water. A decision might be to pull screens and to volitionally release, thereby, reducing the population of an undersized group of fish.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

Steelhead are released from May 1 to May 15, onstation, during high spring glacial runoff, to encourage quick migration to salt water and to provide visual protection for listed chinook juveniles. Thus, this release time reduces residualism and possible predation by these steelhead on salmonids, especially listed chinook.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

11.1) Monitoring and evaluation of "Performance Indicators" presented in Section 1.10.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program.

The comanagers conduct numerous ongoing monitor programs, including catch, escapement, marking, tagging, and fish health testing. The focus of enhanced monitoring and evaluation programs will be on the risks posed by ecological interactions with listed species. WDFW is proceeding on four tracks:

1) An ongoing research program conducted by Duffy et al. (2002) is assessing the nearshore distribution, size structure, and trophic interactions of juvenile salmon, and potential predators and competitors, in northern and southern Puget Sound. Funding is provided through the federal Hatchery Scientific Review Group.

2) A three year study of the estuarine and early marine use of Sinclair Inlet by juvenile salmonids is nearing completion. The project has four objectives:

a) Assess the spatial and temporal use of littoral habitats by juvenile chinook throughout the time these fish are available in the inlet;
b) Assess the use of offshore (i.e., non-littoral) habitats by juvenile chinook;
c) Determine how long cohorts of juvenile chinook salmon are present in Sinclair inlet;
d) Examine the trophic ecology of juvenile chinook in Sinclair Inlet. This will consist of evaluating the diets of wild chinook salmon and some of their potential predators and competitors.

Funding is provided by the USDD-Navy.

3) WDFW is developing the design for a research project to assess the risks of predation on listed species by coho salmon and steelhead released from artificial production programs. Questions which this project will address include:

a) How does trucking and the source of fish (within watershed or out of watershed) affect the migration rate of juvenile steelhead?
b) How many juvenile chinook salmon of natural origin do coho salmon and steelhead consume?
c) What is the rate of residualism of steelhead in Puget Sound rivers?

Funding needs have not yet been quanitifed, but would likely be met through a combination of federal and state sources.

4) WDFW is assisting the Hatchery Scientific Review Group in the development of a template for a regional monitoring plan. The template will provide an integrated assessment of hatchery and wild populations.

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

See Section 11.1.1

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

Risk aversion measures will be developed in conjunction with the monitoring and evaluation plans.

SECTION 12. RESEARCH

12.1) Objective or purpose.

Not applicable.

12.2) Cooperating and funding agencies.

12.3) Principle investigator or project supervisor and staff.

12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.

12.5) Techniques: include capture methods, drugs, samples collected, tags applied.

12.6) Dates or time period in which research activity occurs.

12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.

12.8) Expected type and effects of take and potential for injury or mortality.

12.9) Level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached "take table" (Table 1).

12.10) Alternative methods to achieve project objectives.

12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.

12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the foregoing information is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:

Certified by_____________________________ Date:_____________

Table 1. Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: Chinook ESU/Population: Puget Sound Activity: Hatchery Operations				
Location of hatchery activity: Kendall Cr./McKinnon Ponds Dates of activity: December-May Hatchery program operator: WDFW				
Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)				
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)	Unknown	Unknown		
Other Take (specify) h)				

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.

Instructions:

1. *An entry for a fish to be taken should be in the take category that describes the greatest impact.*
2. *Each take to be entered in the table should be in one take category only (there should not be more than one entry for the same sampling event).*
3. *If an individual fish is to be taken more than once on separate occasions, each take must be entered in the take table.*